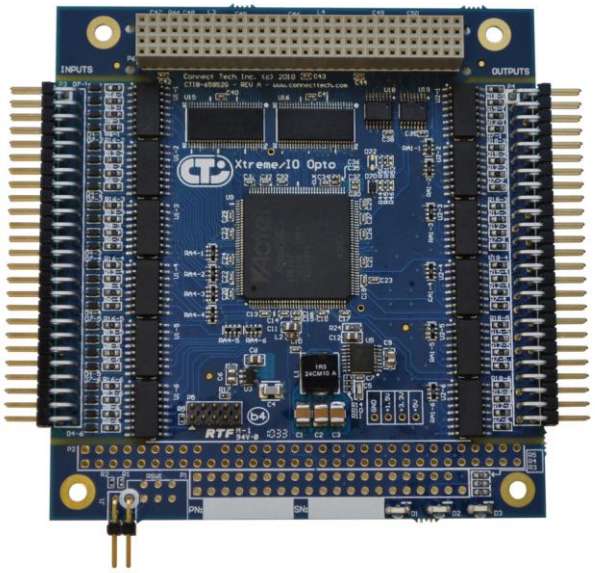
Connect Tech Inc.
Industrial Strength Communications

Xtreme I/O Family
User Manual



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Limited Lifetime Warranty

Connect Tech Inc. provides a lifetime warranty for all of our products. Should this product, in Connect Tech Inc.'s opinion, fail to be in good working order during the warranty period, Connect Tech Inc. will, at its option, repair or replace this product at no charge, provided that the product has not been subjected to abuse, misuse, accident, disaster or non Connect Tech Inc. authorized modification or repair.

You may obtain warranty service by delivering this product to an authorized Connect Tech Inc. business partner or directly to Connect Tech Inc. along with proof of purchase. Product returned to Connect Tech Inc. must be pre-authorized by Connect Tech Inc. with an RMA (Return Material Authorization) number marked on the outside of the package and sent prepaid, insured and packaged for safe shipment. Connect Tech Inc. will return this product by prepaid ground shipment service.

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Revision History

Revision	Date	Author(s)	Change(s)
0.00	2010-09-02	Patrick Dietrich	

Customer Support Overview

If you experience difficulties after reading the manual and/or using the product, contact the Connect Tech Inc. reseller from which you purchased the product. In most cases the reseller can help you with product installation and difficulties.

In the event that the reseller is unable to resolve your problem, our highly qualified support staff can assist you. Our support section is available 24 hours a day, 7 days a week on our website at: www.connecttech.com/sub/support/support.asp. See the contact information section below for more information on how to contact us directly. Our technical support is always free.

Contact Information

We offer three ways for you to contact us:

Mail/Courier

You may contact us by letter at:

Connect Tech Inc.
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42 Arrow Road, Guelph, ON
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Email/Internet

You may contact us through the Internet. Our email and URL addresses on the Internet are:
sales@connecttech.com
support@connecttech.com
www.connecttech.com

Note:
Please go to the **Download Zone** or the **Knowledge Database** in the **Support Center** on the Connect Tech Inc. website for product manuals, installation guides, device driver software and technical tips. Submit your technical support questions to our customer support engineers via the **Support Center** on the Connect Tech Inc. website.

Telephone/Facsimile

Technical Support representatives are ready to answer your call Monday through Friday, from 8:30 a.m. to 5:00 p.m. Eastern Standard Time. Our numbers for calls are:

Telephone:	800-426-8979 (North America only)
Telephone:	519-836-1291 (Live assistance available 8:30 a.m. to 5:00 p.m. EST, Monday to Friday)
Facsimile:	519-836-4878 (online 24 hours)

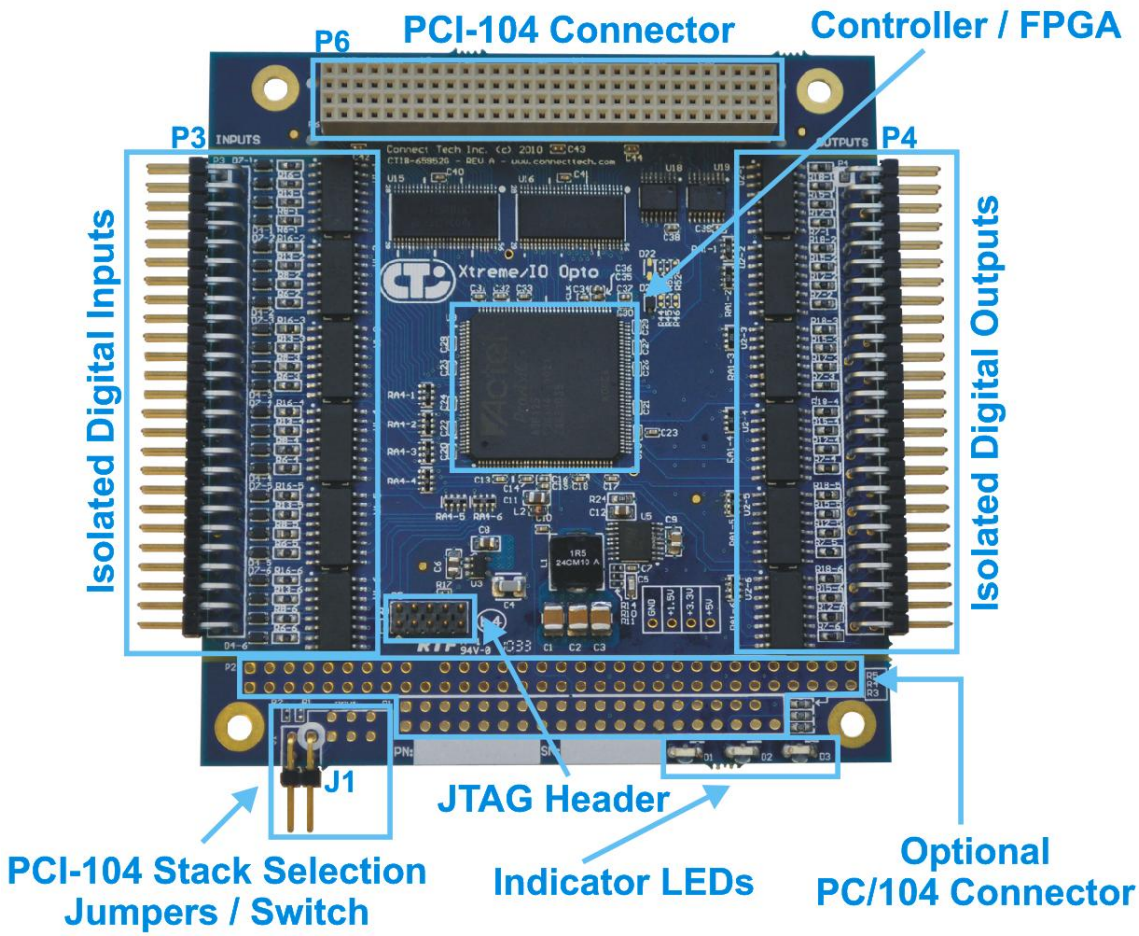
Introduction

Connect Tech's Xtreme I/O Opto is a 48-bit isolated digital input/output board grouped with 24 optically isolated inputs and 24 optically isolated outputs. The flexibility of the FPGA technology applied to the Xtreme I/O Opto enables high functionality integration and customization to meet application requirements. Fully PCI-104 compliant, Xtreme I/O Opto can be controlled directly from a memory mapped register set in any operating system. The reliability of the Xtreme I/O Opto, along with the added protection provided by 2kV isolation ensures optimal performance and protection under extreme environmental conditions. Xtreme I/O Opto is ideal for embedded technology applications in the military, aerospace, medical and industrial sectors.

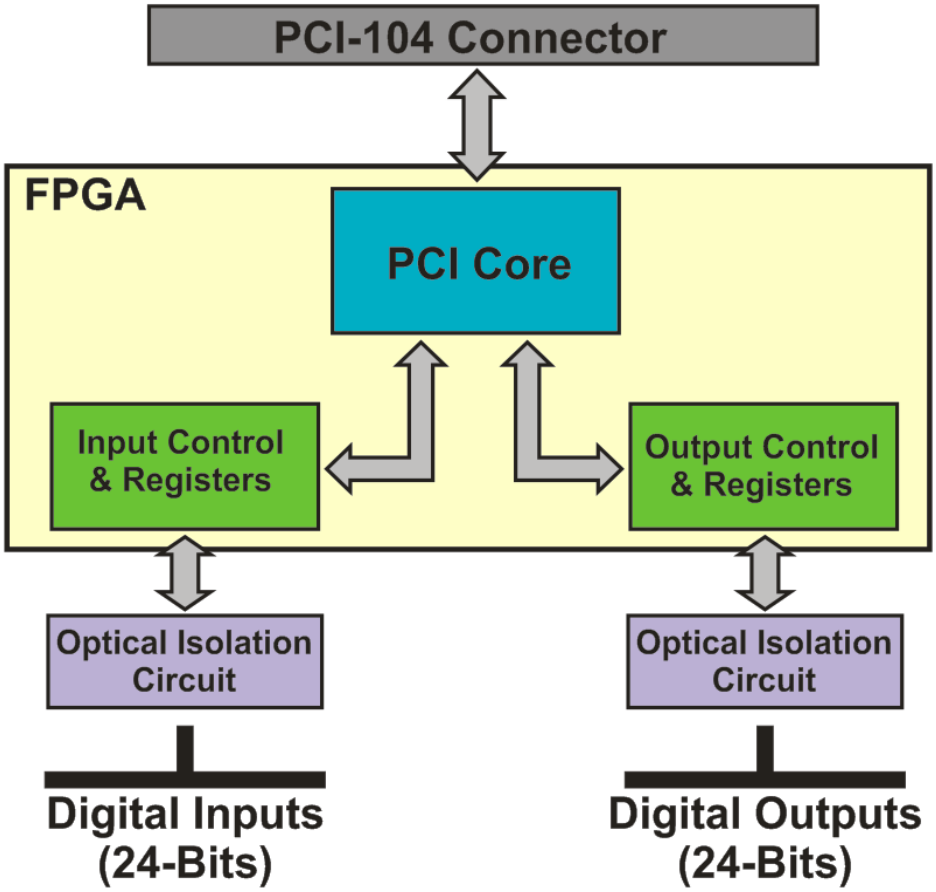
Product Features

Specification	Details
Inputs	• 24 optically isolated inputs (24-bits) • Wide input voltage range from +0 up to +40V DC • All inputs have independent grounds as well as reverse voltage protection • Selectable interrupt generation on any input signal (change of state, rising or falling edge) • 1.8kOhm current limiting series resistor on each input
Outputs	• 24 optically isolated outputs (24-bits) • Wide output voltage range from +0 up to +40V DC • All outputs are open collector configuration with common emitter connections • Individual selectable output voltage levels with a 4.7kOhm pull up • Wide output voltage range from +0 up to +40V DC • Maximum output current: 8mA
Connectors	• 2x25 (50 position) 0.1" (DIL) Pin Headers • Available in Vertical or Right Angle
Bus	• PCI-104 (PC/104-Plus)
Optical Isolation	• 2 kV RMS
Controller	• FPGA Register Controlled Device (No jumpers needed) • Custom logic available upon request
Operating Temperature	• -40 to +85 Degrees Celsius
Dimensions	• 3.775" x 3.550" (PC/104 Compliant)
Bus	• PCI-104 (PC/104-Plus) • ISA (PC/104) connector can be optionally installed as a pass-through connector
Software Compatibility	• Custom CTI Device Drivers for QNX, Linux, Windows • Device can also be controlled directly from a memory mapped register set in any operating system
Warranty and Support	• Lifetime Warranty • Free Technical Support

Board Diagram



Block Diagram



Digital Outputs

Connector P4 is located on the right side of the board and uses a 50-pin double row (25x2pin with 2.54mm pitch) connector. This connector is has right angle headers but can also ship in a vertical header configuration. There are 24 separate isolated digital outputs which each have a pin to source external power, and a pin for the actual output itself. All the isolated digital outputs share a common ground. Each of the output signal is configured in an open collector configuration with a 4.7 kOhm pull-up resistor to a external output voltage VOUT+. The Xtreme/IO uses Avago's DC Input Multi-Channel Phototransistor Optocouplers to perform the optical isolation process.

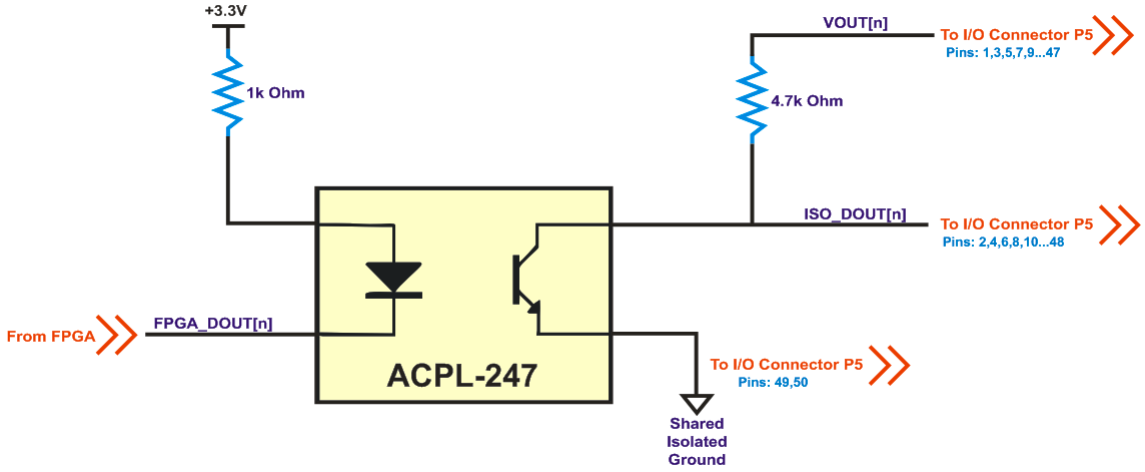
The Xtreme/IO Opto ships from with these properties electrical properties:

VOUT Properties (Externally Supplied)
VOUT (max) +40Vdc
VOUT(min) +0Vdc

ISO_DOUT Current
8mA typical

Response Time
2µs typical within 0-40Vdc input range

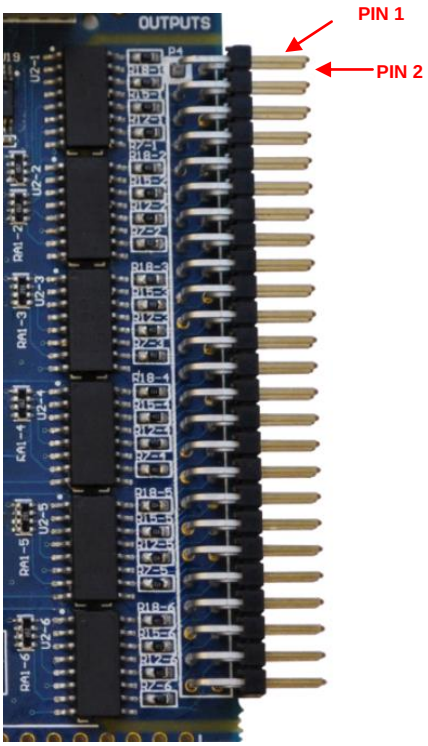
Digital Outputs Circuit Diagram



Custom Output Configuration
If your design requires different electrical properties the 4.7kOhm pull-up resistor can be changed to suit your needs. Please contact Connect Tech Technical Support (support@connecttech.com) to request a custom configuration.

Isolated Digital Outputs Connector Pinout (P4)

Pin Number	Description	Pin Number	Description
1	VOUT1	2	ISO_DOUT1
3	VOUT2	4	ISO_DOUT2
5	VOUT3	6	ISO_DOUT3
7	VOUT4	8	ISO_DOUT4
9	VOUT5	10	ISO_DOUT5
11	VOUT6	12	ISO_DOUT6
13	VOUT7	14	ISO_DOUT7
15	VOUT8	16	ISO_DOUT8
17	VOUT9	18	ISO_DOUT9
19	VOUT10	20	ISO_DOUT10
21	VOUT11	22	ISO_DOUT11
23	VOUT12	24	ISO_DOUT12
25	VOUT13	26	ISO_DOUT13
27	VOUT14	28	ISO_DOUT14
29	VOUT15	30	ISO_DOUT15
31	VOUT16	32	ISO_DOUT16
33	VOUT17	34	ISO_DOUT17
35	VOUT18	36	ISO_DOUT18
37	VOUT19	38	ISO_DOUT19
39	VOUT20	40	ISO_DOUT20
41	VOUT21	42	ISO_DOUT21
43	VOUT22	44	ISO_DOUT22
45	VOUT23	46	ISO_DOUT23
47	VOUT24	48	ISO_DOUT24
49	Shared Isolated Ground	50	Shared Isolated Ground



Digital Inputs

Connector P3 is located on the left side of the board and uses a 50-pin double row (25x2pin with 2.54mm pitch) connector. This connector is has right angle headers but can also ship in a vertical header configuration.

The Xtreme/IO uses Avago's DC Input Multi-Channel Phototransistor Optocouplers to perform the optical isolation process. The ISO_DIN+ input pins on the 50 pins connector are connected with 1.8kOhm series resistor for current limiting and to setup the proper switching level. Connect the signal output of your device to the ISO_DIN+ pin and the ground of output signal to the ISO_DIN- pin.

The Xtreme/IO Opto ships from with these properties electrical properties:

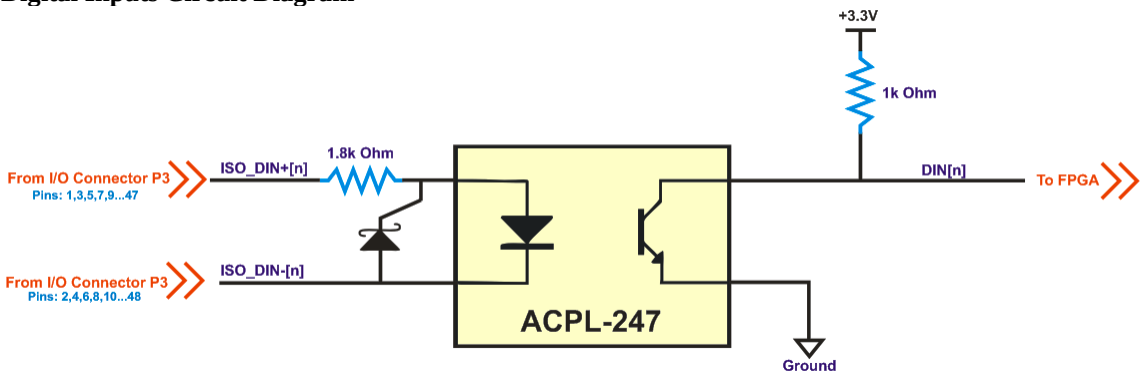
ON / HIGH State
V_{IH}(max) +40Vdc
V_{IH}(min) +3.3Vdc

OFF / LOW State
V_{IL}(max) +1.8Vdc
V_{IL}(min) +0Vdc

Response Time
2µs typical within 0-40Vdc input range

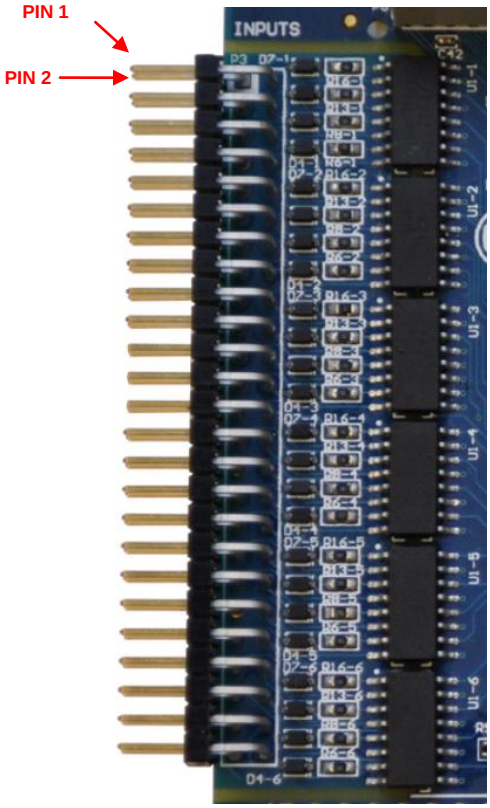
Input Current Consumption Ratings
@ 5Vdc V_{IH} 2.8mA
@ 12Vdc V_{IH} 6.6mA
@ 24Vdc V_{IH} 13.3mA
@ 30Vdc V_{IH} 16.7mA
@ 40Vdc V_{IH} 22.2mA

Digital Inputs Circuit Diagram



Custom Input Configuration
If your design requires different electrical properties the 1.8kOhm series resistor can be changed to suit your needs. Please contact Connect Tech Technical Support (support@connecttech.com) to request a custom configuration.

Digital Inputs Pinout for Connector P3



Pin Number	Description	Pin Number	Description
1	ISO_DIN+1	2	ISO_DIN-1
3	ISO_DIN+2	4	ISO_DIN-2
5	ISO_DIN+3	6	ISO_DIN-3
7	ISO_DIN+4	8	ISO_DIN-4
9	ISO_DIN+5	10	ISO_DIN-5
11	ISO_DIN+6	12	ISO_DIN-6
13	ISO_DIN+7	14	ISO_DIN-7
15	ISO_DIN+8	16	ISO_DIN-8
17	ISO_DIN+9	18	ISO_DIN-9
19	ISO_DIN+10	20	ISO_DIN-10
21	ISO_DIN+11	22	ISO_DIN-11
23	ISO_DIN+12	24	ISO_DIN-12
25	ISO_DIN+13	26	ISO_DIN-13
27	ISO_DIN+14	28	ISO_DIN-14
29	ISO_DIN+15	30	ISO_DIN-15
31	ISO_DIN+16	32	ISO_DIN-16
33	ISO_DIN+17	34	ISO_DIN-17
35	ISO_DIN+18	36	ISO_DIN-18
37	ISO_DIN+19	38	ISO_DIN-19
39	ISO_DIN+20	40	ISO_DIN-20
41	ISO_DIN+21	42	ISO_DIN-21
43	ISO_DIN+22	44	ISO_DIN-22
45	ISO_DIN+23	46	ISO_DIN-23
47	ISO_DIN+24	48	ISO_DIN-24
49	No Connect	50	No Connect

PCI-104 Information

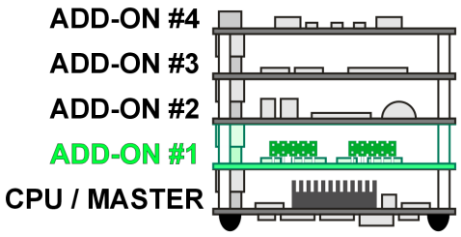
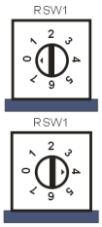
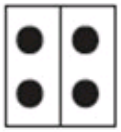
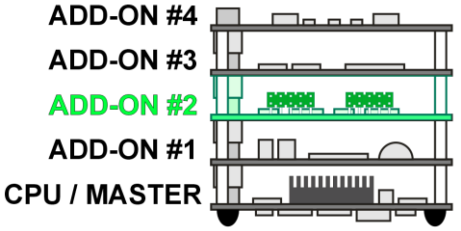
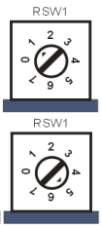
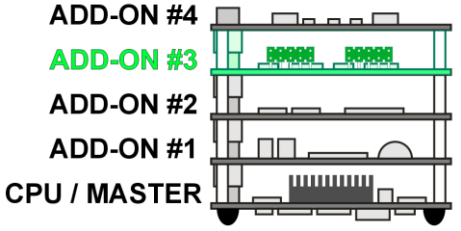
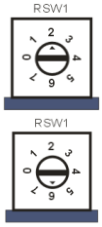
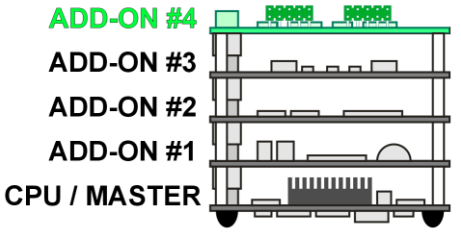
PCI-104 Connector Pinout (P6)

Connector P6 is connects to the PCI-104 bus, a full listing of the pinout of the connector is found in the table below.

Pin	A	B	C	D
1	GND	Reserved	+5	AD00
2	VI/O	AD02	AD01	+5V
3	AD05	GND	AD04	AD03
4	C/BE0#	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VI/O	AD10	M66EN
7	AD14	AD13	GND	AD12
8	+3.3V	C/BE1#	AD15	+3.3V
9	SERR#	GND	Reserved	PAR
10	GND	PERR#	+3.3V	Reserved
11	STOP#	+3.3V	LOCK#	GND
12	+3.3V	TRDY#	GND	DEVSEL#
13	FRAME#	GND	IRDY#	+3.3V
14	GND	AD16	+3.3V	C/BE2#
15	AD18	+3.3V	AD17	GND
16	AD21	AD20	GND	AD19
17	+3.3V	AD23	AD22	+3.3V
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3#	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5V	AD28	AD27
22	+5V	AD30	GND	AD31
23	REQ0#	GND	REQ1#	VI/O
24	GND	REQ2#	+5V	GNT0#
25	GNT1#	VI/O	GNT2#	GND
26	+5V	CLK0	GND	CLK1
27	CLK2	+5V	CLK3	GND
28	GND	INTD#	+5V	RST#
29	+12V	INTA#	INTB#	INTC#
30	-12V	REQ3#	GNT3#	GND

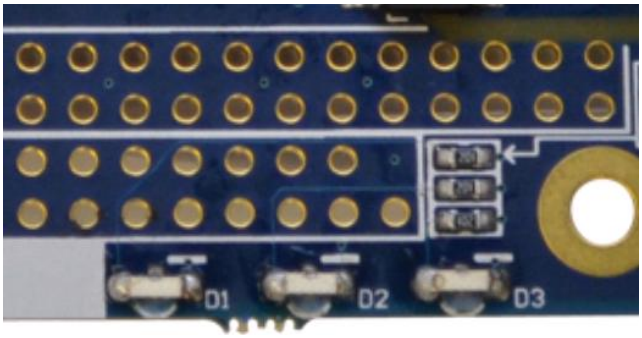
PCI-104 Stack Position Selection

The following PCI signals, (INTA#, INTB# INTC# INTD#), (CLK0, CLK1,CLK2, CLK3), (IDSEL0, IDSEL1, IDSEL2, IDSEL3), are selected by using the jumper block or rotary switch (optionally installed) on the Xtreme/IO Opto board (J1 / RSW1). Selections need to match the stack location of the Xtreme/IO Opto in your PCI-104 stack. See the table below for more details.

Stack Location	Rotary Switch Setting	Jumper Block Setting	PCI INT#	PCI CLK	PCI IDSEL
			INTA#	CLK0	IDSEL0
			INTB#	CLK1	IDSEL1
			INTC#	CLK2	IDSEL2
			INTD#	CLK3	IDSEL3

LED Indicators

The Xtreme/IO Opto has 3 indicator LEDs as shown below. LED D1 will quickly pulse whenever it detects a change in value to any of the ISO_DIN pins. LED D2 will quickly pulse whenever there is a change in value to any of the ISO_DOUT pins. LED D3 is the "heartbeat" indicator, the LED should flash on and off continuously to indicate the Xtreme/IO is operating properly.



D1 – Input Change
D2 – Output Change
D3 – Xtreme/IO "Heartbeat"

If LED D3 is not flashing at all times when the Xtreme/IO is powered up please contact Connect Tech Technical Support (support@connecttech.com).

Device Software/Configuration Information

PCI Device Information

The Xtreme/IO product will have the following properties in a PCI system.

PCI Vendor ID: 0x12C4
PCI Device ID: 0x1200
PCI Class Code: 0x0780

The Xtreme/IO has a register bank which is located in the devices BAR 0 location.

Below is the output from the lspci utility in Linux:

```
00:0b.0 Communication controller [0780]: Connect Tech Inc Device [12c4:1200]
    Control: I/O- Mem+ BusMaster- SpecCycle- MemWINV- VGASnoop- ParErr- Stepping-
    SERR- FastB2B- DisINTx-
    Status: Cap+ 66MHz- UDF- FastB2B- ParErr- DEVSEL=slow >TAbort- <TAbort- <MAbort-
    >SERR- <PERR- INTx-
     Interrupt: pin A routed to IRQ 10
     Region 0: Memory at d4000000 (32-bit, non-prefetchable) [size=8K]
```

Device Register Description

All of the Xtreme/IO register control set is will be memory mapped into BAR0 of the PCI device. There are six 32-bit registers which control and show the status of the Xtreme/IO board. Each of these registers bits corresponds to a bit on the digital input (or output) connectors. IE. bit 0 corresponds to Digital I/O signal 0 and bit 23 corresponds to digital I/O signal 23. The uppers bits of each register bits 24 to 31 have no effect on the device, so they can be ignored.

Register Map Overview

Register Decription	Register Name	Read / Write Function	Base Addr + Offset (Hex)	Reg Num
ISOLATED DIGITAL OUTPUT	DOUT	R / W	0x00	0
ISOLATED DIGITAL INPUT	DIN	R	0x04	1
INTERRUPT STATUS/SOURCE	ISDIN	R	0x08	2
INTERRUPT ENABLE/DISABLE	IEDIN	R/W	0x0C	3
INTERRUPT TRIGGER MODE	ITDIN	R/W	0x10	4
INTERRUPT CLEAR	ICDIN	R/W	0x14	5

The following pages will give further details and description of each register and how it controls the Xtreme/IO product.

Isolated Digital Output Register (DOUT)

General Description: This register is used to directly control the state of the ISO_DOUT pins on connector P4. Each bit 0-23 of the register directly corresponds to a pin on the connector. This pins state will follow that of the register. So once a value is set the ISO_DOUT pins will hold that state on until it is changed again in the DOUT register.

Read / Write Capabilities: Both **Read and Write** functions are permitted with this register.

Register Memory Location: BAR0 BASE + 0x00

Logic Description: 0 = ISO_DOUT Pin will be LOW*
1 = ISO_DOUT Pin will be HIGH*
** the V_{HL} and V_{LL} will depend on what voltage is applied to the corresponding VOUT Pin*

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	DOUT7	DOUT6	DOUT5	DOUT4	DOUT3	DOUT2	DOUT1	DOUT0

Bit	15	14	13	12	11	10	9	8
Name	DOUT15	DOUT14	DOUT13	DOUT12	DOUT11	DOUT10	DOUT9	DOUT8

Bit	23	22	21	20	19	18	17	16
Name	DOUT23	DOUT22	DOUT21	DOUT20	DOUT19	DOUT18	DOUT17	DOUT16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

Isolated Digital Input Register (DIN)

General Description: This register is used to show the state of the ISO_DIN pins on connector P3. Each bit 0-23 of the register directly corresponds to a pin on the connector. The registers state will follow that of the input pin.

Read / Write Capabilities: This register is configured for **Read Only** functionality.

Register Memory Location: BAR0 BASE + 0x04

Logic Description: 0 = ISO_DIN Pin is currently in a LOW state
1 = ISO_DIN Pin is currently in a HIGH state

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	DIN7	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1	DIN0

Bit	15	14	13	12	11	10	9	8
Name	DIN15	DIN14	DIN13	DIN12	DIN11	DIN10	DIN9	DIN8

Bit	23	22	21	20	19	18	17	16
Name	DIN23	DIN22	DIN21	DIN20	DIN19	DIN18	DIN17	DIN16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

Interrupt Status/Source Register (ISDIN)

General Description: This register is used to show the state of any active interrupts on the Xtreme/IO device. Each bit 0-23 of the register directly corresponds to the status of interrupt on a ISO_DIN pin on the connector. Interrupts can only be generated (i.e. this register will only change from non-zero) when the Interrupts are enabled from the IEDIN register. When this register is in a non-zero state, a PCI interrupt will be generated from the Xtreme/IO device. The PCI interrupt will remain active until all of the interrupts for each ISO_DIN pin are cleared via the ICDIN register.

Read / Write Capabilities: This register is configured for **Read Only** functionality.

Register Memory Location: BAR0 BASE + 0x08

Logic Description: 0 = Nothing to report, no interrupt has occurred on the ISO_DIN pin
1 = An Interrupt has occurred on the corresponding ISO_DIN pin

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	ISDIN7	ISDIN6	ISDIN5	ISDIN4	ISDIN3	ISDIN2	ISDIN1	ISDIN0

Bit	15	14	13	12	11	10	9	8
Name	ISDIN15	ISDIN14	ISDIN13	ISDIN12	ISDIN11	ISDIN10	ISDIN9	ISDIN8

Bit	23	22	21	20	19	18	17	16
Name	ISDIN23	ISDIN22	ISDIN21	ISDIN20	ISDIN19	ISDIN18	ISDIN17	ISDIN16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

Interrupt Enable/Disable Register (IEDIN)

General Description: This register is used to enable or disable interrupt generation on the ISO_DIN pins. Each bit 0-23 of the register directly corresponds to the ISO_DIN pin on the connector. This register allows the user to configure one or many ISO_DIN pins to be able generate an interrupt based on the interrupt triggering mode set in the ITDIN register.

Read / Write Capabilities: Both **Read and Write** functions are permitted with this register.

Register Memory Location: BAR0 BASE + 0x0C

Logic Description: 0 = Disable interrupt generation from this ISO_DIN pin
1 = Enable interrupt generation from this ISO_DIN pin

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	IEDIN7	IEDIN6	IEDIN5	IEDIN4	IEDIN3	IEDIN2	IEDIN1	IEDIN0

Bit	15	14	13	12	11	10	9	8
Name	IEDIN15	IEDIN14	IEDIN13	IEDIN12	IEDIN11	IEDIN10	IEDIN9	IEDIN8

Bit	23	22	21	20	19	18	17	16
Name	IEDIN23	IEDIN22	IEDIN21	IEDIN20	IEDIN19	IEDIN18	IEDIN17	IEDIN16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

Interrupt Trigger Mode Register (ITDIN)

General Description: This register is used to choose the interrupt trigger mode for each of the ISO_DIN pins. Each bit 0-23 of the register directly corresponds to the ISO_DIN pin on the connector. This register allows the user to configure one or many ISO_DIN pins to trigger an interrupt on either a rising of falling edge.

Read / Write Capabilities: Both **Read and Write** functions are permitted with this register.

Register Memory Location: BAR0 BASE + 0x10

Logic Description: 0 = Trigger an interrupt on a Rising Edge of this ISO_DIN pin
1 = Trigger an interrupt on a Falling Edge of this ISO_DIN pin

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	ITDIN7	ITDIN6	ITDIN5	ITDIN4	ITDIN3	ITDIN2	ITDIN1	ITDIN0

Bit	15	14	13	12	11	10	9	8
Name	ITDIN15	ITDIN14	ITDIN13	ITDIN12	ITDIN11	ITDIN10	ITDIN9	ITDIN8

Bit	23	22	21	20	19	18	17	16
Name	ITDIN23	ITDIN22	ITDIN21	ITDIN20	ITDIN19	ITDIN18	ITDIN17	ITDIN16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

Interrupt Clear Register (ICDIN)

General Description: This register is used to clear an interrupt that has been generated from the ISO_DIN pins. Each bit 0-23 of the register directly corresponds to the ISO_DIN pin on the connector. The user can clear one or all interrupt bits in the IDSIN register with this ICDIN register. It should also be noted that the ICDIN bit corresponding to the ISO_DIN pin must be set back to zero in order for more interrupts to be generated.

Read / Write Capabilities: Both **Read and Write** functions are permitted with this register.

Register Memory Location: BAR0 BASE + 0x14

Logic Description: 0 = Stop clearing interrupts of this ISO_DIN pin
1 = Clear the interrupt of this ISO_DIN pin*
** must be set back to zero to allow for more interrupts to be generated*

Register Layout:

Bit	7	6	5	4	3	2	1	0
Name	ICDIN7	ICDIN6	ICDIN5	ICDIN4	ICDIN3	ICDIN2	ICDIN1	ICDIN0

Bit	15	14	13	12	11	10	9	8
Name	ICDIN15	ICDIN14	ICDIN13	ICDIN12	ICDIN11	ICDIN10	ICDIN9	ICDIN8

Bit	23	22	21	20	19	18	17	16
Name	ICDIN23	ICDIN22	ICDIN21	ICDIN20	ICDIN19	ICDIN18	ICDIN17	ICDIN16

Bit	31	30	29	28	27	26	25	24
Name	-	-	-	-	-	-	-	-

FPGA Custom Configuration

The Xtreme/IO Opto product uses the Actel ProASIC3 A3P125 FPGA its main control and configuration unit. Xtreme/IO Opto ships from Connect Tech with a full featured design pre-loaded into the device. This design allows users to communicate to the control and register portion of the device through the PCI-104 bus. In some situations some customers may find they would like some extra features added into the device that are custom suited for their application. This is where the Xtreme/IO Opto's FPGA custom configuration can be used.

Connect Tech currently offers two solutions for customers looking to implement a custom FPGA design into the Xtreme/IO Opto.

Option #1 – Using the Xtreme/IO Opto Development Kit
Connect Tech offers a full featured development kit that allows experienced FPGA users to design their own HDL to configure the Xtreme/IO Opto's FPGA.
This development kit includes:
- JTAG Programming Cable
- Full VHDL source code for standard reference design
- Actel Libero IDE Software Suite

Option #2 – Using Connect Tech's Custom Design Services
Connect Tech offers a highly skilled team of engineers with years of experience in custom FPGA designs who can efficiently implement whatever solution you are looking for. To request the team's services please send an email to Connect Tech's sales department (sales@connecttech.com) and they can assist with getting your FPGA project underway.